ABSTRACT

Industrial dairy effluents are characterized by high biological oxygen demand (BOD) and chemical oxygen demand (COD) concentrations and contain fats, nutrients, lactose, as well as detergents and sanitizing agents. Due to the high pollution load of dairy wastewater, the milk-processing industries discharging untreated/partially treated wastewater can cause serious environmental problems.

In the present study, treatment of simulated dairy waste water(SDW) by electrocoagulation process has been investigated using aluminum electrodes. Experiments were conducted in a laboratory scale batch reactor. Full factorial central composite design (CCD) was employed for optimization of 4 responses: chemical oxygen demand(COD), 3-day biological oxygen demand(BOD), anode consumption and specific electrical energy consumption(SEEC). Three factors namely current density (1.92-2.88 mA/cm^2), pH (6-8) & conductivity (1000-2000 µS/cm) with each factor at three levels were used. Regression model equations were developed which were validated by high R^2 values of 96.05%, 94.60%, 97.45% and 99.65% for COD, BOD, anode consumption and SEEC respectively. According to normal probability plot of externally studentized residuals, the quadratic model obtained well satisfied the ANOVA. Optimization was targeted for maximum COD removal and minimum operating cost. The optimized conditions as suggested by the model were: applied current density-2.209 mA/cm^2, pH-6.86, and conductivity- 2000 µS/cm. Optimum COD and BOD removal efficiencies were 79.45% and 81.02% respectively while anode consumption and SEEC was 0.065 mg/mg COD and 0.068 J/mg COD respectively. These results were used for experimental verification, which was in good agreement with the predicted results.

The kinetic analysis carried out for the present process indicates that the adsorption system follows pseudo-second-order kinetic model (R^2 =0.9818), and the rate-limiting step is the surface adsorption that involves chemisorption. Finally, the equilibrium data fit well with the Freundlich adsorption isotherm model(R^2=0.9969) and indicate multilayer adsorption taking place.